procedures – those directed at the identification of component parts and those focused on component operations.

Although the goal of discovering the component parts and operations of mechanisms is clear, actually succeeding often requires great ingenuity. Mechanisms generally do not directly reveal how they operate. All we observe is their functioning and often those observations require careful interpretation. Even when the internal operations involve changes in an identifiable substrate, the intermediate states of the substrate can be hidden because in a well-organized machine individual operations flow smoothly into each other without leaving any trace of their intermediate products. Think again of engineering, where the ultimate goal is to design a device of which the user is not even aware and which operates when needed without any intervention by the user. In the early days of a new technology this desiderata is often not realized. Drivers of early automobiles had to understand how they operated so as to be able to repair them after their frequent failures. Users of early computers had to understand their operation at the machine level, or at least at the level of the operating system, in order to get their programs to perform as desired. As computers matured such knowledge became unnecessary and the details of the operation were increasingly hidden from view (e.g., behind a smoothly functioning windowing system and higher-level programming languages).[23] An engineer who wants to emulate a competitor's system but lacks access to the design specifications often faces a serious challenge of reverse engineering – taking the system apart and trying to figure out how it was put together. This is the situation confronting investigators of biological systems who must rely on experimental manipulations to take apart and reveal the parts and operations within them.

Identifying Working Parts

Some experimental inquiries are designed simply to separate the parts of a mechanism. It is important to emphasize that the parts into which researchers seek to decompose a mechanism are ones which perform the operations that figure in the functional decomposition. The majority of ways of structurally decomposing a system will not result in parts that perform operations. As Craver (forthcoming) notes, one might dice any system into cubes, but these cubes do not individually perform operations in terms of which one can explain the phenomenon. To reflect this fact, I will, following Craver, refer to

[23] Herbert Simon (1996) made this point in the context of bridge design. When a bridge is functioning as intended, it reveals little of its design principles.